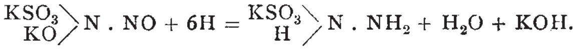
present, Characeæ, Desmidieæ, and Diatomaceæ), from the Arctic Ocean to the Isthmus of Panama, including the West Indies. Each number will include fifty species, and the price will be five dollars. Subscriptions and offers of contributions are to be addressed to Mr. Frank S. Collins, 97 Dexter Street, Mass., U.S.A.

FROM a note in the *Botanical Gazette* we learn that the fox-tail grass or squirrel-tail grass, *Hordeum jubatum*, is a serious pest to stock in the Western States of America. The barbed awns break up into pieces, penetrate the gums, especially near the teeth, producing swelling, and ultimately suppuration, of the gums, and ulceration of the jaw-bones and teeth, the latter being so loosened as to drop out. If the animal continues to eat hay containing this grass, the disease progresses till the bony tissue of the jaws is disarranged, the ulcers extend to all parts of the jaw-bone, and it becomes distorted and enlarged. The marrow-filled interior is changed into great cavities filled with the broken awns. This condition may continue till the cavities extend entirely through the jaw, and the tightly-packed awns protrude till they may be pulled out with forceps or fingers.

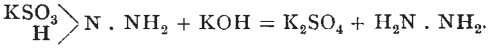
THE completeness of the series of Eocene and Cretaceous strata exposed along the great central river system of Alabama, is well known to American geologists. A report on the geology of the coastal plain of Alabama, just issued by the Geological Survey of that State, shows that, on account of the fine exposures along the river banks, and the great number and perfection of the fossils, the region presents the most complete and varied series of Eocene and Cretaceous strata known in the United States. All that relates to Cretaceous, Tertiary, and Post-Tertiary formations in the vicinity of the Alabama and Tombigbee rivers, is described in the first part of the report. The second part contains all the data of practical value concerning the various phosphatic marls, greensands, &c., occurring in the region surveyed, and the third part includes a number of geological details referring to the different counties of the State. Prof. E. A. Smith, the State Geologist, and those who have assisted him, may be congratulated upon the publication of this important account of the stratigraphy of the Cretaceous and Tertiary formations of the Gulf region of Alabama.

AN inorganic mode of preparing hydrazine, N_2H_4, is described by Dr. Duden, of the Jena University Laboratory, in the latest issue of the *Berichte*. Hitherto the numerous methods of formation of this important hydride of nitrogen, described by its discoverer, Prof. Curtius, and his assistants, and by Thiele and von Pechmann, have all been based upon the decomposition of more or less unstable organic compounds of the diazo, nitrosamine, or nitramine types. Dr. Duden has succeeded in an inorganic synthesis by use of a singular compound, discovered by Davy and further investigated by Raschig and by Divers and Haga, which is produced by the action of sulphurous acid upon potassium nitrite. This compound, whose composition is represented by the formula $K_2SO_3 . N_2O_2$, is now found to yield hydrazine upon careful reduction in alkaline solution. Divers and Haga showed that the ordinary products of reduction of the compound with sodium amalgam in concentrated alkaline solution are mainly potassium hyponitrite KNO and hydrogen potassium sulphite $HKSO_3$, smaller quantities of hydroxylamine and ammonia being likewise produced. Dr. Duden finds that if the reduction with sodium amalgam, or zinc dust and ammonia or soda, is carried out at a low temperature, the solution produced possesses very strong reducing properties, and after acidification deposits the salt of hydrazine corresponding to the acid employed. The freshly prepared compound of potassium sulphite and nitric oxide is suspended in water cooled by ice, and sodium amalgam is gradually added with further extraneous cooling by means of a freezing mixture, until the liquid is found to strongly reduce Fehling's solution and yields, after acidification and warming to expel sulphur dioxide, a precipitate of benzalazine upon the addition of benzaldehyde. The benzalazine so obtained is found to exhibit all the properties of the compound as described by Prof. Curtius; it melts at 93° and yields numbers on analysis exactly agreeing with the formula $(C_6H_5CHN)_2$. With sulphuric acid it yields hydrazine sulphate $(N_2H_4)_2 . H_2SO_4$, identical in melting point (256°) and all other properties with that derived from the organic methods of preparation. The formation of hydrazine from the compound of nitric oxide and potassium sulphite would appear to occur in two stages, an intermediate reduction compound being first produced of analogous constitution to Davy's salt in accordance with the following equation:



$$\left.\begin{matrix}KSO_3\\KO\end{matrix}\right\rangle N\,.\,NO + 6H = \left.\begin{matrix}KSO_3\\H\end{matrix}\right\rangle N\,.\,NH_2 + H_2O + KOH.$$

A further reaction then occurs between the intermediate compound and the alkali, with production of potassium sulphate and hydrazine



$$\left.\begin{matrix}KSO_3\\H\end{matrix}\right\rangle N\,.\,NH_2 + KOH = K_2SO_4 + H_2N\,.\,NH_2.$$

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*, ♀) from India, presented by Mr. H. Ralls; a Black-backed Jackal (*Canis mesomelas*) from South Africa, presented by Mr. Fred Bissmire; a Dusty Ichneumon (*Herpestes pulverulentus*), a White-throated Monitor (*Varanus albigularis*) from South Africa, presented by Mr. J. E. Matcham; a Derbian Wallaby (*Halmaturus derbianus*) from Australia, presented by Mr. Joseph Palmer; a Jackal Buzzard (*Buteo jacal*) from South Africa, presented by Mr. E. Wingate; a Yellow-headed Conure (*Conurus jendaya*) from South-east Brazil, a Brown-throated Conure (*Conurus æruginosus*) from South America, presented by Mrs. Hankey; three Eroded Cinixys (*Cinixys erosa*), two Home's Cinixys (*Cinixys homeana*) from West Africa, presented by Mr. J. Banks Elliot; a Lesueur's Water Lizard (*Physignathus lesueuri*) from Australia, deposited; a Rosy-billed Duck (*Metopiana peposaca*), a Garden's Night Heron (*Nycticorax gardeni*) from South America, purchased.

OUR ASTRONOMICAL COLUMN.

THE PERSEID METEORS.—This well-known shower of meteors should be of the greatest interest to the mathematician, as well as to the observer. At Pulkova, in 1893, the shower was observed from July 22 to September 12, and a discussion of the 563 paths recorded forms the subject of an interesting paper by Dr. Bredichin (*Bull. Imp. Acad. Sc.*, St. Petersburg, September 1894). It has long been known that the Perseids are not as other regularly recurring meteor showers, and Dr. Bredichin explains their peculiarities by supposing that they are not produced by a swarm of meteorites, in the true sense of the word, but by particles circulating in different orbits. These orbits have widely differing inclinations, and the other elements also show striking departures from each other. One gets a good idea of the system which is suggested, by imagining a bundle of materialised orbits crossing the earth's orbit at the points which the earth occupies during August, and for some days before and after. The particles with long periods correspond to the meteors at the beginning of the showers, and to the primitive position of the comet from which the meteors are supposed to be derived, which, having a moderate period, has left these meteors behind. The position of the node of the comet is not symmetrical with reference to the nodes of the meteors, but appears to be nearer the beginning than the end of the showers. This con-

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tinuity of the phenomena for so long a time seems to confirm the idea of a variety of periods for the particles, and indicate also the repeated omission of the meteors from the body of the comet. If the forces of disruption were only those which have ordinarily been considered, the meteors would be dispersed in a long thin stream along the length of the orbit, as in the case of the November meteors; but since the orbits of the meteors are variously inclined to that of the comet, another force, acting transversely to the plane of the orbit, must be admitted as an important factor. The anomalous phenomena of the tails of some comets—a subject with which Dr. Bredichin is already closely associated—and the energetic emissions which have been noted in several comets, including that which is connected with the Perseids, serve to demonstrate the possibility of such an action as that which he supposes to have taken place in the case of this swarm.

COMET 1894 I (DENNING) AND BRORSEN'S COMET.—Dr. Hind contributes to the current number of the *Astronomische Nachrichten* (No. 3271) a very interesting note as to the identity of Denning's comet with that discovered by Brorsen. To investigate the question, he has found, with M. Schulhof's elements for Denning's comet and Dr. Lamp's elements for Brorsen's comet, that the distance of the orbits would be 0·0367 in Longitude 285° (1894·0), and that in April 1881 the comets approached one another within a distance of 0.138. On this account, he says, during the comet's recession from perihelion, might not Brorsen's comet have met with a catastrophe, causing disintegration and the return of a portion of it to perihelion, in a somewhat different orbit, in Denning's comet of last year?

Dr. E. Lamp has also considered this question of identity, and, in referring to Dr. Hind's note, writes that the similarity of the two orbits is very striking, and that, in the beginning of 1881, the two bodies must have been very close to one another near the point of intersection of the two orbits. With the same elements as used by Dr. Hind, he finds the point of intersection of the orbits in Longitude 284° 47′ and South Latitude 1° 57′. The places of the two bodies are then as follows:—

	Denning.	Brorsen.
	° ′	° ′
True anomaly	154 22	169 7
Ecc. anomaly	123 22	147 25
Radius vector	5·240	5·218

The point of nearest approach in the orbit of Denning's comet occurs in a position 5′ behind, and in the Brorsen's orbit 4′ before, the actual place, the distance between these points being 0·022 radii of the earth's orbit. Dr. Lamp suggests that, by decreasing Schulhof's value of the mean daily motion by about 28″, the comets would thus be brought together. The question, however, is in a very undecided state, but astronomers will await with interest the results of Dr. Lamp's investigation as to whether the comets furnish an instance of a mere approach or of a real physical connection.

STARS HAVING PECULIAR SPECTRA.—Prof. E. C. Pickering states in the *Astronomische Nachrichten*, No. 3269, that an examination of photographs of stellar spectra, taken at the Arequipa Station of the Harvard College Observatory, has led to the discovery of four new variable stars in Centaurus, Lupus, Pavo, and Microscopium, and ten other objects with spectroscopic peculiarities. Of these, the spectra of five are classified as Type IV.; two appear to belong to Type V.; one (R.A. 18h. 38·4m. Decl. −27° 55′) is a nebula; one has $H\beta$ bright; and the photographic spectrum of the remaining object contains no blue light. To show how difficult it is to draw any sharp distinction between nebulæ and bright line stars, we quote the concluding paragraph of Prof. Pickering's communication. "The photographic spectra of faint gaseous nebulæ and stars of the fifth type closely resemble each other, and can only be distinguished by the wave-length of the principal bright line. In gaseous nebulæ this line (5007) is of greater wave-length than $H\beta$, while in stars of the fifth type, the line 4688 is of shorter wave-length. A superposition of a chart and spectrum plate of the star whose approximate position for 1900 is R.A. = 15h. 10m. Decl. −45° 17′, which has been announced as a star of the fifth type (*Astronomische Nachrichten*, vol. 135, p. 195), shows that this object is in reality a gaseous nebula."

NITROGEN FIXATION IN ALGÆ.

IN NATURE of March 29, 1894, Prof. Marshall Ward gave a clear and excellent *résumé* of certain aspects of the question of nitrogen fixation in plants. Since the publication of that article, fresh and most important additions have been made to the subject.

Last May, P. Kossowitsch published an account of his experiments on Algæ in respect to their nitrogen-fixing powers (*Bot. Zeitung*, May 16, 1894), and a short account of this contribution should form an appropriate supplement to Prof. Ward's paper.

In 1888, Prof. Frank, of Berlin, had stated his opinion that Algæ possessed the power of free nitrogen fixation.

In 1892, Messrs. Schloesing and Laurent published an account of their classical researches dealing with many plants, among which Algæ also found a place. Their experiments with these forms range in two series. In the first they found that if they kept soil, covered with Algæ and containing bacteria of certain kinds, under observation for some time, an increase in nitrogen was perceptible. On the other hand, if they prevented the formation of Algæ, although the same bacteria remained, there was no noticeable addition to the nitrogen of the system. In the second set of experiments, in which different Algæ were employed, no nitrogen fixation could be perceived. It was evident from this that either particular kinds of Algæ only have "fixing" powers, or that suitable bacteria were not simultaneously present in the second case, and that Algæ can only fix with the additional aid of these micro-organisms.

In the following year, Koch and Kossowitsch devoted their attention to the subject, and went over much the same ground as Laurent and Schloesing, confirming their results, and adding new facts, the value of which, however, was somewhat enhanced by the algal cultures never consisting of any single species alone, but of several intermingled. Accordingly when, in 1894, Kossowitsch set himself the task of determining whether Algæ in themselves possess the power of assimilating free atmospheric nitrogen or not, the first obstacle he had to overcome was the difficulty of finding a method by which he could obtain a single algal species in absolute purity. This was ultimately effected by growing the Algæ on gelatinous silicic acid permeated with a nutritive solution, and subsequently on sterilised sand also containing food solution. The steps by which the isolation was effected were slow and beset with difficulties, which sprang up in the most unexpected manner, and the pages of Kossowitsch's memoir which deal with this subject possess a separate and great interest of their own; space, however, will not permit that the matter be detailed here. Having obtained the Algæ in a state of purity, the next step was to transfer them to the apparatus in which their nitrogen-fixing powers were to be tested.

This consisted of a central air-tight vessel connected with a series of U-tubes, which were blown into bulbs at certain intervals. These bulbs contained strong sulphuric acid. The whole apparatus was sterilised, and the Algæ under consideration sown upon a sterilised nutritive substratum in the central vessel. Air freed from all traces of nitrogen compounds was blown into the vessel through the U-tubes, the sulphuric acid in which killed any organisms which might be contained in this air.

The Alga which was first experimented on was Cystococcus (or an extremely similar form). Every precaution was taken in introducing this into the apparatus.

Using a nutritive solution perfectly free from all nitrates, it was seen that the Algæ refused to show any signs of growth; it was clear, therefore, that at least to start development a trace of nitrate must be added to the sand. The addition of other nitrogen compounds was found to be useless, and accordingly a small and accurately measured quantity of a nitrate was mixed with the food solution in the central vessel. The whole apparatus thus fixed up was placed in the light, and left for some weeks. At first rapid increase in the Algæ was noticeable, but after the lapse of about three weeks things evidently came to a standstill.

The addition of more nitrate-free nutritive solution gave no result; but if only the merest trace of a nitrate were added, there was an immediate resumption of activity.

These facts in themselves are very good proof of the inability of Cystococcus to fix atmospheric nitrogen; but to make matters doubly sure, a careful chemical analysis was made. This showed

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